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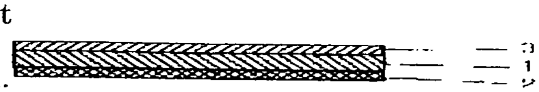
(54) TITLE OF THE INVENTION

OPTICAL COMPENSATION FILM AND LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an optical compensation film which is superior in thinness, lightness and heat resistance and having polarizing function.



SOLUTION: A phase difference layer 2 and a polarizing layer 3 consisting of a coating film are at least adhered to a base film 1, to efficiently manufacture the optical compensation film and a liquid

crystal cell superior in visibility and a visual field angle can be formed. A liquid crystal display has the optical compensation film.

[Claims]

[Claim 1] An optical compensation film comprising at least a laminate having a phase difference layer and a polarizing layer consisting of a coating film are formed on a support film.

[Claim 2] An optical compensation film according to Claim 1, wherein said phase difference layer is made of a liquid-crystal polymer layer.

[Claim 3] An optical compensation film according to Claim 1 or 2, wherein said polarizing layer is made of one member selected from the group consisting of a Lyotropic liquid-crystal dichromatic dye, a dichromatic dye-containing liquid-crystal polymer layer, or a dichromatic dye-containing lyotropic substance.

[Claim 4] An optical compensation film according to Claims 1 to 3, wherein a support film has said phase difference layer on one side and has said polarizing layer on the other side.

[Claim 5] An optical compensation film according to Claims 1 to 4, wherein said polarizing layer has a thickness of not larger than 5 μm, and has a protective layer on the surface.

[Claim 6] A liquid-crystal display apparatus characterized by comprising an optical compensation film according to Claim 1 to 5.

[DEATILED DESCRUPTION OF THE INVENTION]

[0001]

[Field of the Invention]

The present invention relate to an optical compensation film which has a polarizing function capable of forming a liquid-crystal display apparatus, and which is excellent in heat resistance, in reduction in thickness and weight and is also excellent in viewing angle of good recognition.

[0002]

[Description of the Prior Art]

There has been heretofore known an optical compensation film having a polarization function, which has been obtained in such a manner that a phase difference layer provided with an obliquely oriented layer of a discotic or nematic type liquid-crystal polymer on a transparent film (Japanese Patent Publication No. 6-21416), and a polarizing plate of a polarizing film type have been adhesively laminated. However, since the polarizing plate has been a 5-layer structure provided with transparent protective films on both sides of a polarizing film through adhesive layers and a total thickness thereof has generally been 100 μm or more, there have been problems that reduction in thickness and weight has been insufficient, and use of a polarizing film has been difficult at 80℃ or more, because heat resistance thereof has been insufficient.

[0003]

[SUMMARY OF THE INVENTION]

An object of the present invention is to develop an optical compensation film having a polarizing function, which is excellent in reduction in thickness and weight and in heat resistance.

[0004]

[MEANS FOR SOLVING THE PROBLEMS]

The present invention provides an optical compensation film formed of at least a laminate having a phase difference layer and a polarizing layer consisting of a coating film on a support film, and a liquid-crystal display apparatus comprising the optical compensation film.

[0005]

[EFFECT OF THE INVENTION]

According to the present invention, a polarizing layer which is excellent in reduction in thickness and heat resistance can be provided to a support film with a coating method to produce efficiently, and an optical compensation film which is excellent in reduction in thickness and weight, and in heat resistance can be obtained, so that it is possible to form a liquid-crystal display apparatus which is excellent in viewing angle of good recognition by using it.

[0006]

[Embodiments of the Invention]

An optical compensation film according to the present invention is formed of at least a laminate comprising a phase difference layer and a polarizing layer consisting of a coating film on a support film. The examples are shown in Figs. 1 to 3. Reference numeral 1 represents a support film; 2, a phase difference layer; 3, a polarization layer; and 4, a protective layer provided as occasion demands. As shown in the drawings, the optical compensation film can be formed with suitable layer configurations such as a configuration that the support film 1 has the phase difference layer 2 on one side and the polarizing layer 3 on the other side, a configuration that the support film 1 has the phase difference layer 2 and the polarizing layer 3 on the same side, or the like.

[0007]

A film made of a suitable transparent polymer film can be used as the support film without any particular limitation. Especially, there can be preferably used a film which is excellent in transparency, mechanical strength, thermal stability, and moisture sealability, and is excellent in uniformity of thickness so that the phase difference is as small as possible. Incidentally, examples of said polymer includes; a cellulose-based resin such as cellulose triacetate; a polyester-based resin, a polycarbonate-based resin, a polyamide, a polyimide-based resin, a polyethersulfone-based resin, a polysulfone-based resin, a polystyrene-based resin,

an acrylic-based resin, a polyolefine-based resin, a norbornene-based resin, or the like. The thickness of the support film can be suitably determined for the purpose of the strength or the like, and from the point of view of reduction in weight or the like, is set to be not larger than 500 μm, especially in a range of from 5 to 300 μm, further especially in a range of from 10 to 200 μm.

[0008]

The phase difference layer which is adhesively laminated to the support film aims to compensate a phase difference caused by birefringence of a liquid-crystal cell, and prevent coloring or the like caused by visual angle change based on the phase difference, and widening a viewing angle with good visibility; and can be formed with a phase difference layer having suitable birefringence property, such as a stretched film layer, an obliquely orientated liquid-crystal polymer layer or the like in accordance with that purpose. Incidentally, an obliquely oriented layer of a discotic or nematic type liquid-crystal polymer may be advantageously used for widening the viewing angle.

[0009]

To adhesively support the phase difference layer by the support film can be performed a suitable method, for example a film laminating method through an adhesives layer used as needed, a coating method of polymer liquid, or the like; when

performing an orienting process of the liquid-crystal polymer, an orientation film, such as a rubbing processing layer, may be involved as needed. A thickness of the phase difference layer can be suitably determined according to the phase difference or the like, and at typically at most 300 μm, preferably from 0.1 to 100 μm, more preferably from 0.5 to 50 μm.

[0010]

The polarizing layer which is adhesively laminated to the support film aims to provide a polarizing function to the optical compensation film; and in the present invention, in order to make a polarizing layer having a layer thickness as thin as possible, is formed as a coating film coated by a suitable coating method, such as a casting method, a spin coating method or the like. From a point of view of reduction in thickness of the optical compensation film, the thickness of the polarization layer, taking polarizing characteristic, durability or the like into account, is not larger than 15 μm, especially in a range of from 0.1 to 5 μm, further especially in a range of from 0.2 to 3 μm.

[0011]

Thus, a suitable material can be used for forming the polarizing layer by the coating method without any particular limitation. Especially, from a point of view of obtaining a polarizing layer which is excellent in heat resistance or the

like, a lyotropic liquid-crystal dichromatic dye, a dichromatic dye-containing liquid-crystal polymer, a dichromatic dye-containing lyotropic substance, or the like (for example, tradename LC Polarizer, made by Optiva Inc.) are preferably used (PCT Publication WO97/39380).

[0012]

Incidentally, a water-soluble organic dye, for example, represented by the formula: (chromogen) $(SO_3M)_n$, can be used as the lyotropic liquid-crystal dichromatic dye, wherein chromogen is made of an azo or polycyclic compound or the like and gives mesomorphism, and sulfonic acid or its salt gives water-solubility, and the water-soluble organic dye exhibits lyotropic mesomorphism as a whole (Japanese Patent Publication No. 8-511109).

[0013]

Incidentally, specific examples of the dichromatic dye include compounds represented by the following formulae (1) to (7).

[Chemical formula 1]

[0014]

In the formula (1), R1 is hydrogen or chlorine, and R is hydrogen, alkyl radical, ArNH or ArCONH. The alkyl radical preferably has 1 to 4 carbon atoms, especially, methyl radial or ethyl radical is preferably used as the alkyl radial, and substituted or non-substituted phenyl radical is preferably

used as the aryl radical (Ar), especially, phenyl radical having the fourth position replaced by chlorine is preferably used as the aryl radical (Ar). Further, M is cation, hydrogen ion, ion of Group I metal such as Li, Na, K or Cs, ammonium ion or the like is preferably used as the cation (this rule applies hereunder).

[0015]

[Chemical formula 2]

[Chemical formula 3]

[Chemical formula 4]

[0016]

In said formulae (2) to (4), A is represented by the formula (a) or (b) in which R2 is hydrogen, alkyl radical, halogen or alkoxy radical, Ar is substituted or non-substituted aryl radial, and n is equal to 2 or 3. Said alkyl radial preferably has 1 to 4 carbon atoms, especially, methyl radical or ethyl radical is preferably used as the alkyl radical, and bromine or chlorine is preferably used as the halogen. Further, alkoxy radical preferably has 1 or 2 carbon atoms, especially, methoxy radical is preferably used as the alkoxy radical, and substituted or non-substituted phenyl radical is preferably used as the aryl radical, especially, non-substituted phenyl radical or phenyl radical having the fourth position replaced by methoxy radical, ethoxy radical, chlorine or butyl radical and the third position replaced by methyl radical is preferably

used as the aryl radical.

[0017]

[Chemical formula 5]

[0018]

In the formula (5), n is preferably an integer of from 3 to 5.

[0019]

[Chemical formula 6]

[0020]

[Chemical formula 7]

[0021]

The organic dye represented by above formula: (chromogen)$(SO_3M)_n$ exhibits a stable liquid-crystal phase based on the chromogen, is soluble in water or in a water-soluble organic solvent such as acetone, alcohol, or dioxane; and when, for example, a solution of solids concentration of 1 to 20% by weight of at least one kind of dye obtained in such a manner is applied by a suitable coating method using the action of shearing force such as a doctor blade method, an orienting process can be performed, and the oriented solidified layer obtained thus exhibits a dichromatic polarizing function.

[0022]

On the other hand, a suitable polymer exhibiting uniaxial orienting characteristic can be used as the liquid-crystal polymer containing the dichromatic dye and exhibiting a

polarizing function. Incidentally, for example, the polymer maybe represented by the following formula (8) (Japanese Patent Publication No. 11-101964).

[Chemical formula 8]

[0023]

The liquid-crystal polymer may be obtained by polymerization of at least one of liquid-crystal monomers represented by the following formulae (a) to (d) on the basis of irradiation with ultraviolet rays (Japanese Patent Publication No. 11-101964).

[Chemical formula a]

[Chemical formula b]

[Chemical formula c]

[Chemical formula d]

[0024]

On the other hand, a suitable dye can be used as the dichromatic dye to be contained in the liquid-crystal polymer layer without any particular limitation. From the point of view to obtain a polarizing layer excellent in heat resistance, dyes represented by the following formulae (9) to (11) may be preferably used (Japanese Patent Publication No. 11-101964).

[Chemical formula 9]

[Chemical formula 10] [0025]

[Chemical formula 11]

[0026]

In the formulae (9) and (10), R4 is hydrogen, halogen, C_nH_{2n+1}, COC_nH_{2n+1}, $OCOC_nH_{2n+1}$, $COOC_nH_{2n+1}$ or $CH_2COOC_nH_{2n+1}$. Further, each of R5 and R6 is hydrogen or C_nH_{2n+1}, and R6 may be one of radicals represented by the following formulae (e) or (f). Further, each of R5 and R6 may be represented by the following formula (g). On the other hand, R7 is hydrogen, halogen, or C_nH_{2n+1}. Incidentally, n is an integer of from 1 to 8, and m is an integer of from 1 to 5.

[0027]

[Chemical formula e]

[Chemical formula f]

[Chemical formula g]

[0028]

On the other hand, in the formula (11), A1 is C_nH_{2n+1} or a radical represented by the following formula in which n is an integer of from 1 to 8.

[Chemical formula 0028]

[0029]

Further, in the formula (11), B is one of radicals represented by the following formulae (h) to (k) in which R8 is C_nH_{2n+1} or $C_nH_{2n}OCH_3$ in which n is an integer of from 1 to 8.

[Chemical formula h]

[Chemical formula i]

[Chemical formula j]

[Chemical formula k]

[0030]

In the above description, the formation of the polarizing layer can be performed in such a method, for example that a dichromatic dye is mixed with a solution containing at least one kind of liquid-crystal polymer and the mixture solution is applied on an oriented film to thereby orient the liquid-crystal polymer uniaxially. A solvent is generally used for dissolving the liquid-crystal polymer to set the solids concentration of the liquid-crystal polymer to be in a range of from 1 to 20% by weight; and however when liquid-crystal monomer is polymerized by ultraviolet rays, the use of such a solvent may be avoided. Further, as the dichromatic dye, at least one kind of dichromatic dye can be used in accordance with the wavelength region of polarizing characteristic, and the amount of use of the dichromatic dye is generally in a range of from 1 to 20% by weight with respect to the weight of the liquid-crystal polymer or monomer.

[0031]

An example of the liquid-crystal polymer containing the dichromatic dye and exhibiting a polarizing function is represented by the formula (12) (Nitto Technical Report Vol.35, No.1 (1997), pp79-82).

[Chemical formula 12]

Incidentally, in the formula, n is an integer of from 1 to 10, R9 is an alkoxy radical such as a cyano radical or a methoxy

radical, and m is an integer of from 1 to 5.

[0032]

As shown in Fig. 2, the protective layer 4 provided as needed on the polarizing layer 3 aims to prevent mar which disturbs viewing. Therefore, the protective layer can be formed by a suitable material such as polymers which is illustrated in the description for the support film, and which does not disturb an optical compensation function. Especially, there can be preferably used a suitable crosslinkable resin which contains multifunctional monomer capable of being crosslinked three-dimensionally by irradiation with ultraviolet rays through a photocatalyst to thereby form a transparent hard film of an ultraviolet-curable resin such as an urethane-acrylic resin or an epoxy resin.

[0033]

Formation of the protective layer can be formed by a film laminating method or the like, however from a point of view of reduction in thickness, it can be formed in such a method that a polymer liquid or a resin liquid is spread on a predetermined surface by a suitable coating method such as a casting method, a spin coating method, a dipping method, or the like for example, and then a crosslinking process is performed, as occasion demands. The thickness of the protective layer can be determined suitably and is generally set to be not larger than 200 μm, especially not larger than 100 μm, and further

especially in a range of from 1 to 50 μm. Incidentally, as shown in Fig. 3, also when the polarizing layer 3 is formed on the phase difference layer 2, from a point of view of preventing deterioration of the phase difference layer or the like, it is preferable to form polarizing layer using a method through the protective layer 4 based on the above description. Similarly, the phase difference layer may also be formed on the polarizing layer.

[0034]

The optical compensation film according to the present invention can be preferably used for the formation of a liquid-crystal display apparatus, or the like. In that case, the phase difference layer and the polarizing layer are integrally laminated on each other in advance; and hence, there is an advantage that variation in quality owing to displacement of the optical axis is hardly generated so that efficiency in assembling the liquid-crystal display apparatus is excellent. For the formation of the liquid-crystal display apparatus, the optical compensation film may be disposed on one side or both sides of opposite surfaces of the liquid-crystal cell. In this case, either of the phase difference layer and the polarizing layer may be provided on the liquid-crystal display cell side, an arrangement structure in which the phase difference layer is located between the polarizing layer and the liquid-crystal cell is generally preferred from the point of view of the

compensating effect or the like. Incidentally, the liquid-crystal cell applied is optionally selected from a TN type cell, an STN type cell, a TFT type cell, a ferroelectric liquid-crystal type cell, and so on.

[0035]

[EXAMPLE]

EXAMPLE 1

An exposed surface of a triacetic acid cellulose film of a phase difference plate (WV film made by Fuji Photo Film Co., Ltd.) provided with an obliquely oriented liquid-crystal polymer layer on one side of said triacetic acid cellulose film was coated with a dichromatic dye-containing lyotropic liquid-crystal aqueous solution (LC Polarizer with a solids concentration of 8.7% by weight, made by Optiva Corp.) by wire bar (No.7), then the solution was dried at 80℃ to form a 1.3 μm-thick polarizing layer; and thus, an optical compensation film was obtained.

[0036]

Said optical compensation film had a total thickness of 110 μm, a light transmittance of 40% in a wavelength range of from 400 to 700 nm, and a polarization degree of 90%; and when a durability test was performed thereon at 90℃, for 500 hours, any changes in optical properties were not found, and deformation or the like of the compensation film was not caused either.

[0037]

EXAMPLE 2

An optical compensation film was obtained in a same manner as EXAMPLE 1 except that an exposed surface of a triacetic acid cellulose film of the WV film was spin-coated with a polyvinyl alcohol and a rubbing processing was performed on the surface with a rayon cloth, then a dichromatic dye-containing liquid-crystal polymer solution was spin-coated thereon, the solution was heated at 100℃ and oriented to form a 1.5 μm-thick polarizing layer, subsequently, a 5 μm-thick protective layer consisting of a urethane-acrylic resin was formed thereon. This optical compensation film had a total thickness of 110 μm, a light transmittance of 38% in a wavelength range of from 400 to 700 nm, and a polarization degree of 88%; and when a durability test was performed thereon at 90℃, for 500 hours, any changes in optical properties were not found, and deformation or the like of the compensation film was not caused either.

[0038]

Incidentally, said liquid-crystal polymer solution contains 26% by weight of side-chain liquid-crystal polymer represented by the following formula 0.37% by weight of G-202 dye (made by Nippon Kannko Sikiso Co., Ltd., the followings are the same) 0.73% by weight of G-207 dye and 1.46% by weight of G-429 dye which are uniformly mixed by 100% by weight of

tetrachloroethane.

[Chemical formula 0038]

[0039]

Further, a urethane-acrylic resin represented by the following formula was coated, then ultraviolet rays were irradiated thereon to form a 5 μm-thick crosslinking layer, so that said protective layer was obtained.

[Chemical formula 0039]

[0040]

COMPARATIVE EXAMPLE

An optical compensation film was obtained in a same manner as EXAMPLE 1 except that instead of the polarizing layer, a 215 μm-thick polarizing plate (NPF-G1225DUN made by Nitto Denko Corp.) was adhesively laminated through a 25 μm-thick acrylic adhesive layer. This optical compensation film had a total thickness of 349 μm, a light transmittance of 38% in a wavelength range of from 400 to 700 nm, and a polarization degree of 99%; and when a durability test was performed thereon at 90℃, for 500 hours, optical properties were deteriorated, besides the compensation film became curled extremely, thus the compensation film could not be put into practical use.

[0041]

The optical compensation films obtained according to EXAMPLE 2 and COMPARATIVE EXAMPLE were laminated on a TN liquid crystal cell through a 25 μm-thick acrylic adhesive layer, and

when a durable test was performed thereon at 90℃, for 240 hours, as a result, although in the optical compensation film according to EXAMPLE 2, any changes in display state by lighting were not recognized, in COMPARATIVE EXAMPLE, however frame-shaped unevenness due to optical distortion was observed.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view showing an embodiment of an optical compensation film according to the present invention;

Fig. 2 is a sectional view showing other embodiment of an optical compensation film according to the present invention; and

Fig. 3 is a sectional view of still other embodiment of an optical compensation film according to the present invention.

SYMBOL

1: support film

2: phase difference layer

3: polarizing layer

4: protective layer